

# Agile Iterative Reservoir Modelling

SIS Forum 2019

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Subsurface Technology Lead



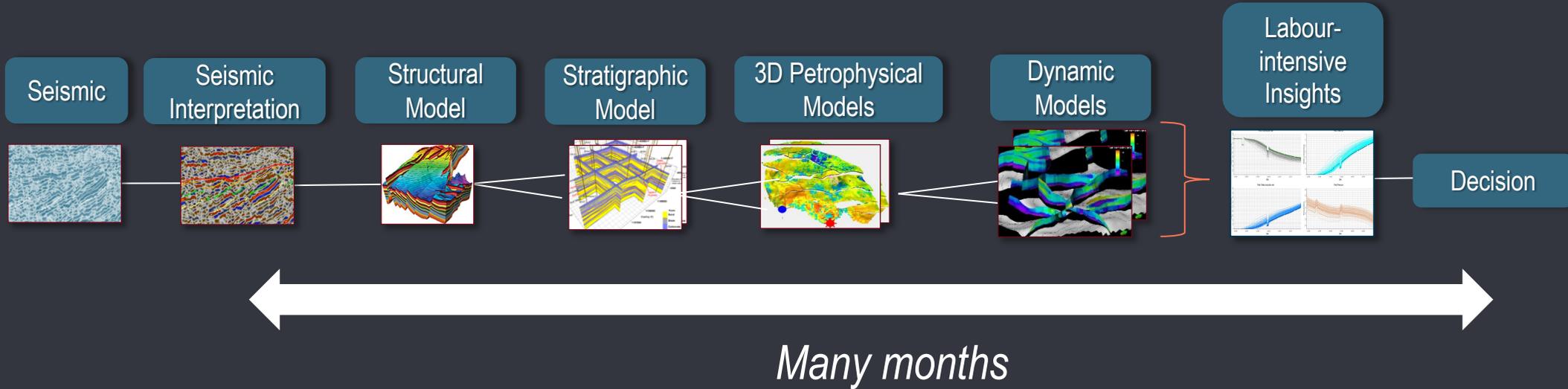
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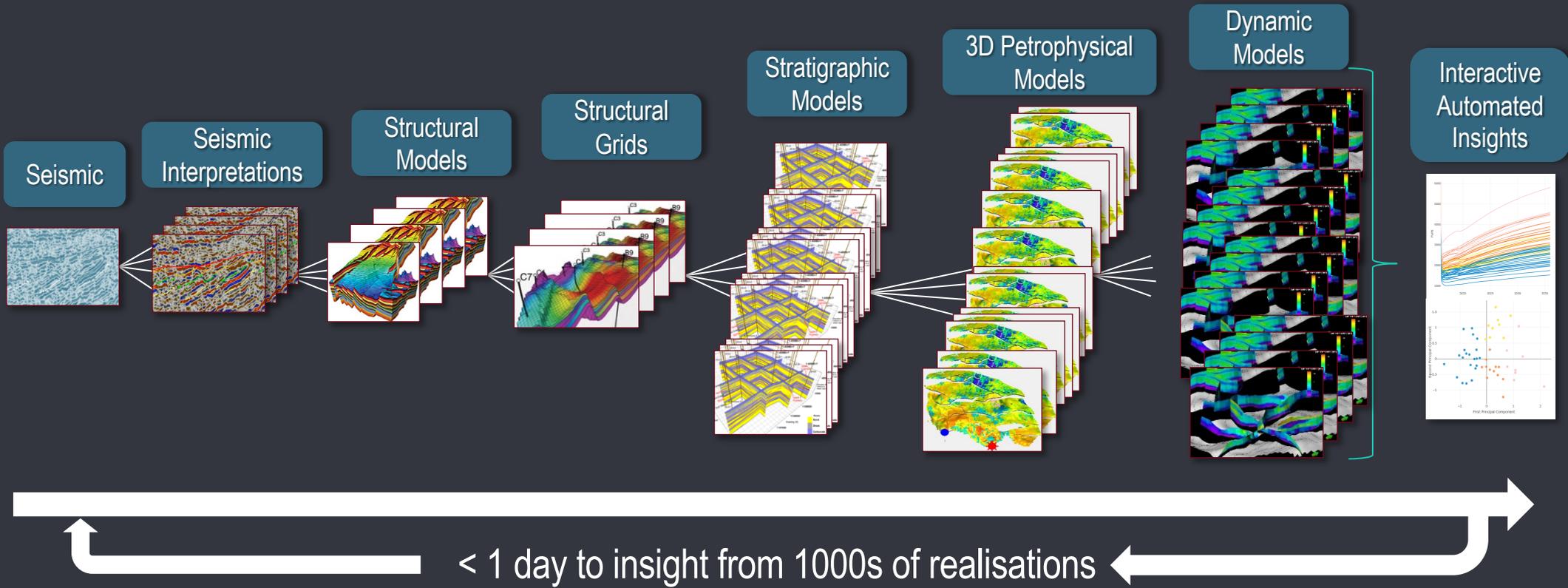
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# The Subsurface Interpretation Challenge



*Limited realisations, limited integration, linear*

# The Subsurface Interpretation Challenge



# Agile Iterative Reservoir Modelling

Woodside worked with Schlumberger to explore what is possible with the new technology behind DELFI and show the power of openness for reservoir modelling

## Objectives:

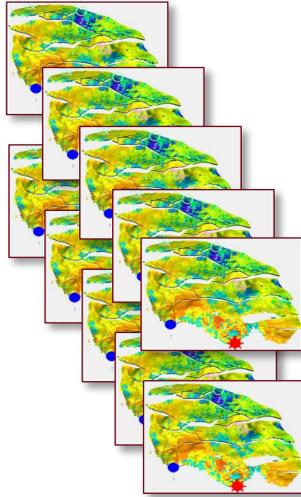
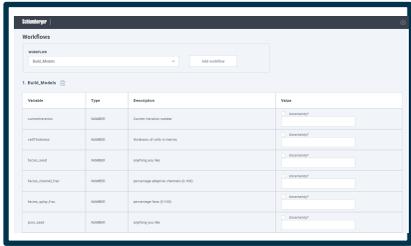
- Build an assisted reservoir modelling application to:
  - Reduce reservoir modelling cycle time
  - Enable collaborative, iterative working styles for integrated teams
  - Improve information for decision-making
  - Unlock subsurface and production data for next-level analysis
- Explore the flexibility and openness of DELFI by developing a new tool inside the DELFI environment
- Enable assisted quality control at each step to build trust in the process



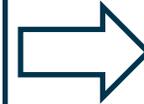
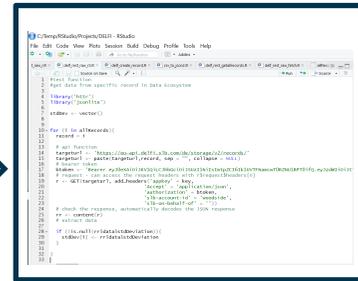
# Agile Iterative Reservoir Modelling

Parallel Petrel and Intersect processes

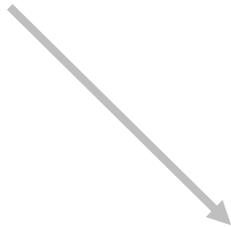
DELFI web app



Woodside Analytics Engine



Spotfire



Data Ecosystem



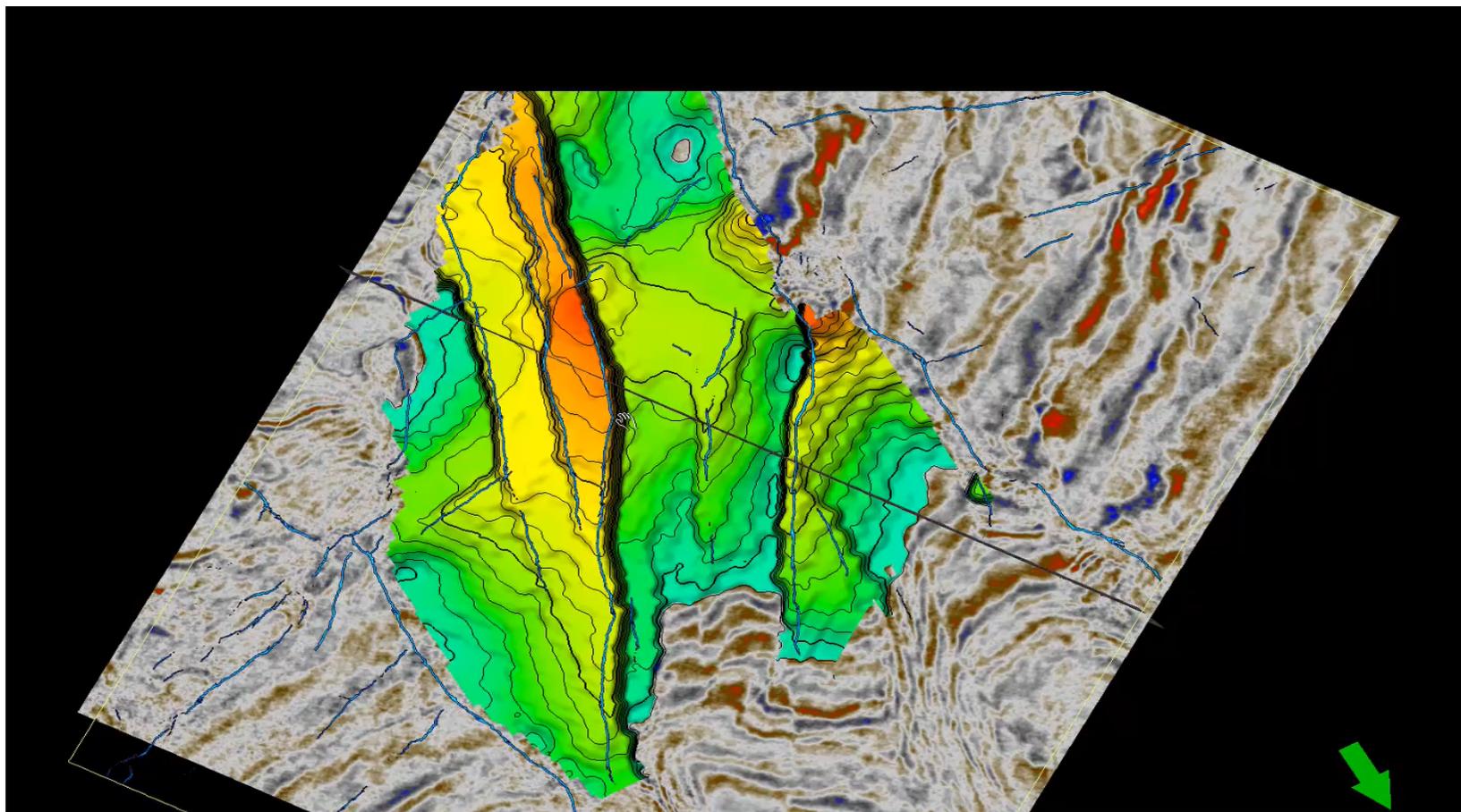
# Greenfield Development Application

**Objective: field development insights with focus on subsurface uncertainty**

- Full modelling workflow from seismic interpretation to simulation
- Incorporated Schlumberger's seismic interpretation and static model automation
- Quality control incorporated at all steps – tracked throughout process using Data Ecosystem and viewable on Spotfire
- Process is automated and highly parallelisable

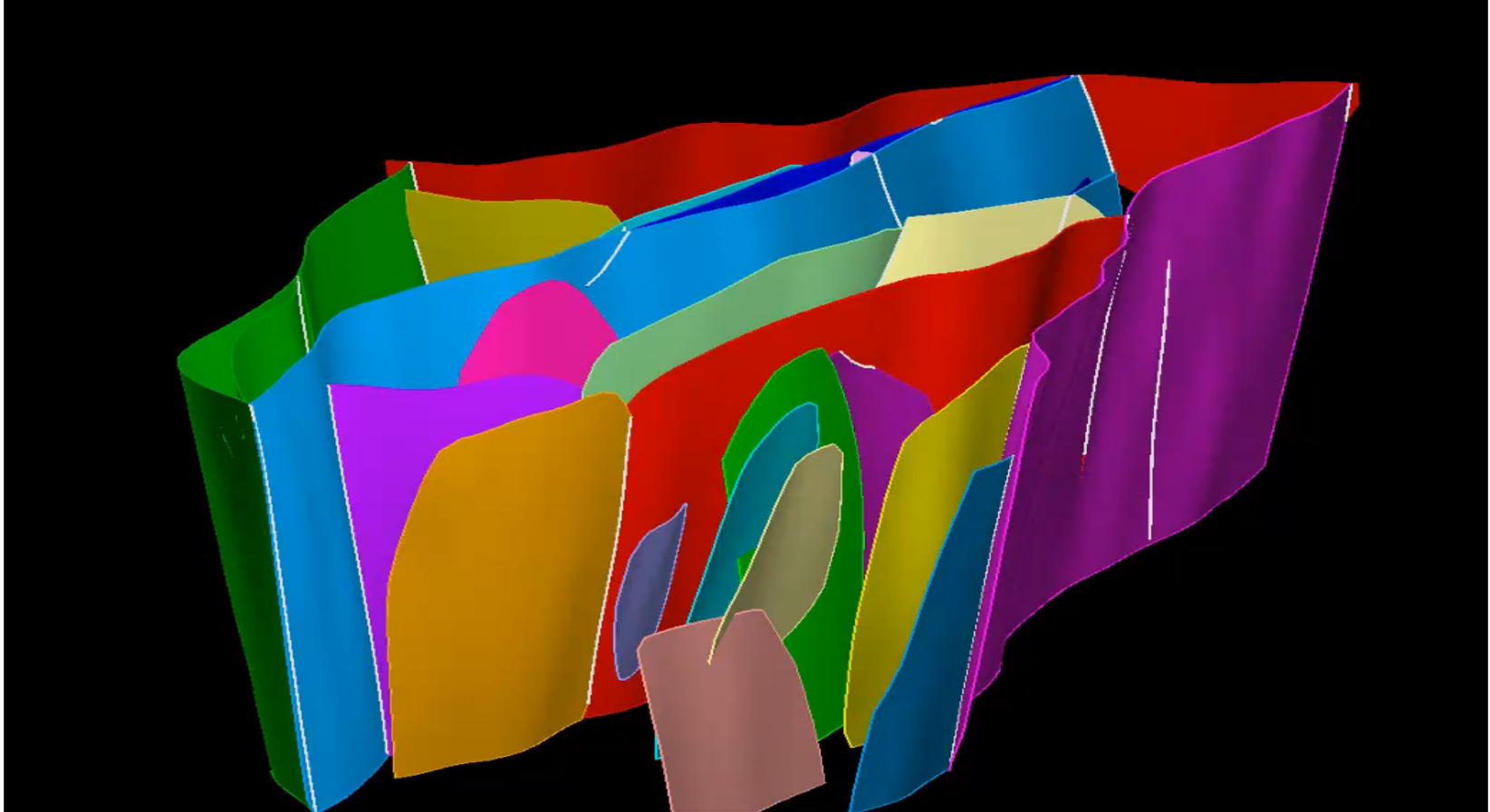


# Automated Structural Modelling

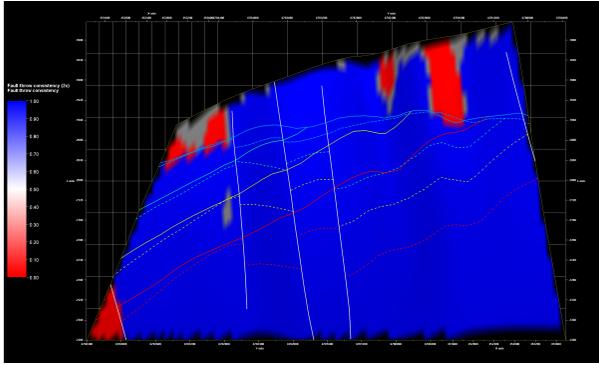


Courtesy of Schlumberger

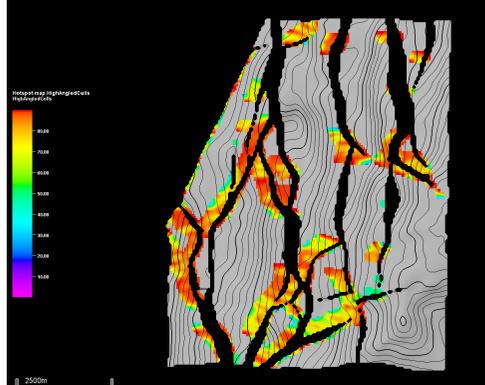
# Automated Static Modelling



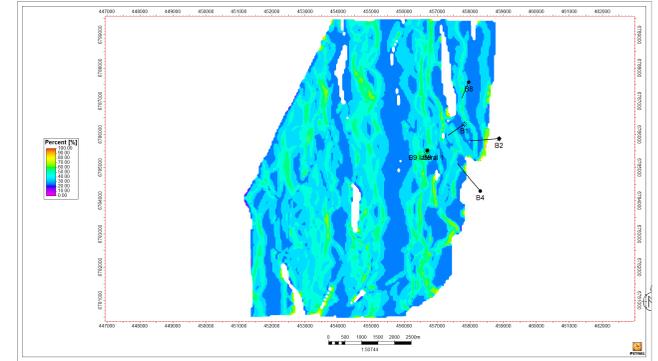
# Assisted QC



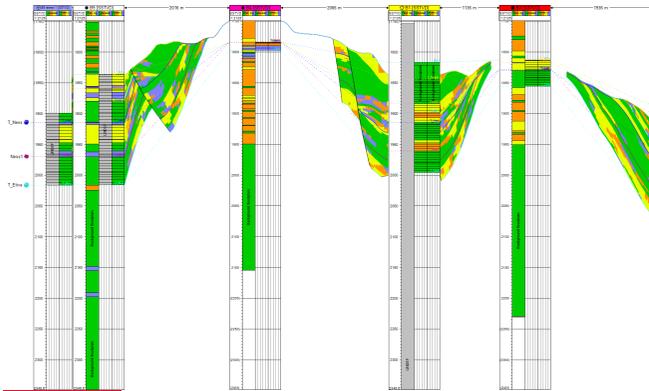
Fault throw consistency



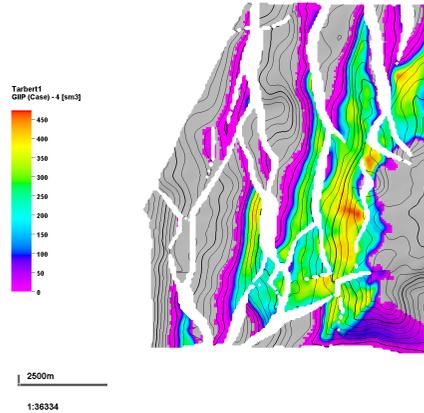
Problem cell hotspot map



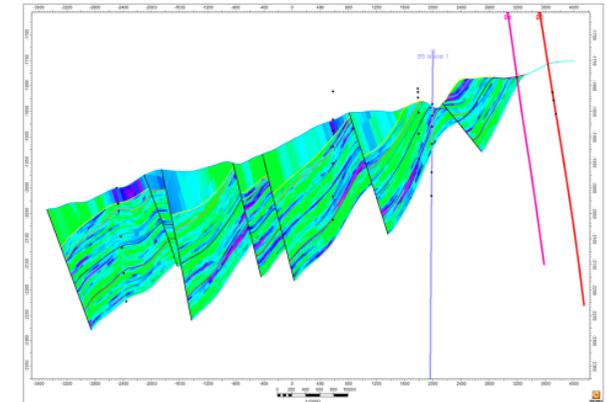
Facies proportion map



Well section



GIIP map



Model cross-section

# Automated Static Modelling

DELFI | Automated static modeling

PROTOTYPE: Automated static modeling

Version 2

Please load the workflow metadata file before doing anything.

static\_modeling\_workflow\_params.txt

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### Iteration

Iteration id  4d357da6-0604-4548-7e91-a209b1c1c489

Start date Mon Jun 25 2018 10:05:28 GMT+0100 (British Summer Time)

#### Workflow sequence

Name   Requires GPU

Workflows

Select the workflow that will be run during the realisations.

#### Workflow data

Variable	Context	Description	Type	Value	Uncertainty (mean, sd)
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#### Realisations



# Automated Static Modelling

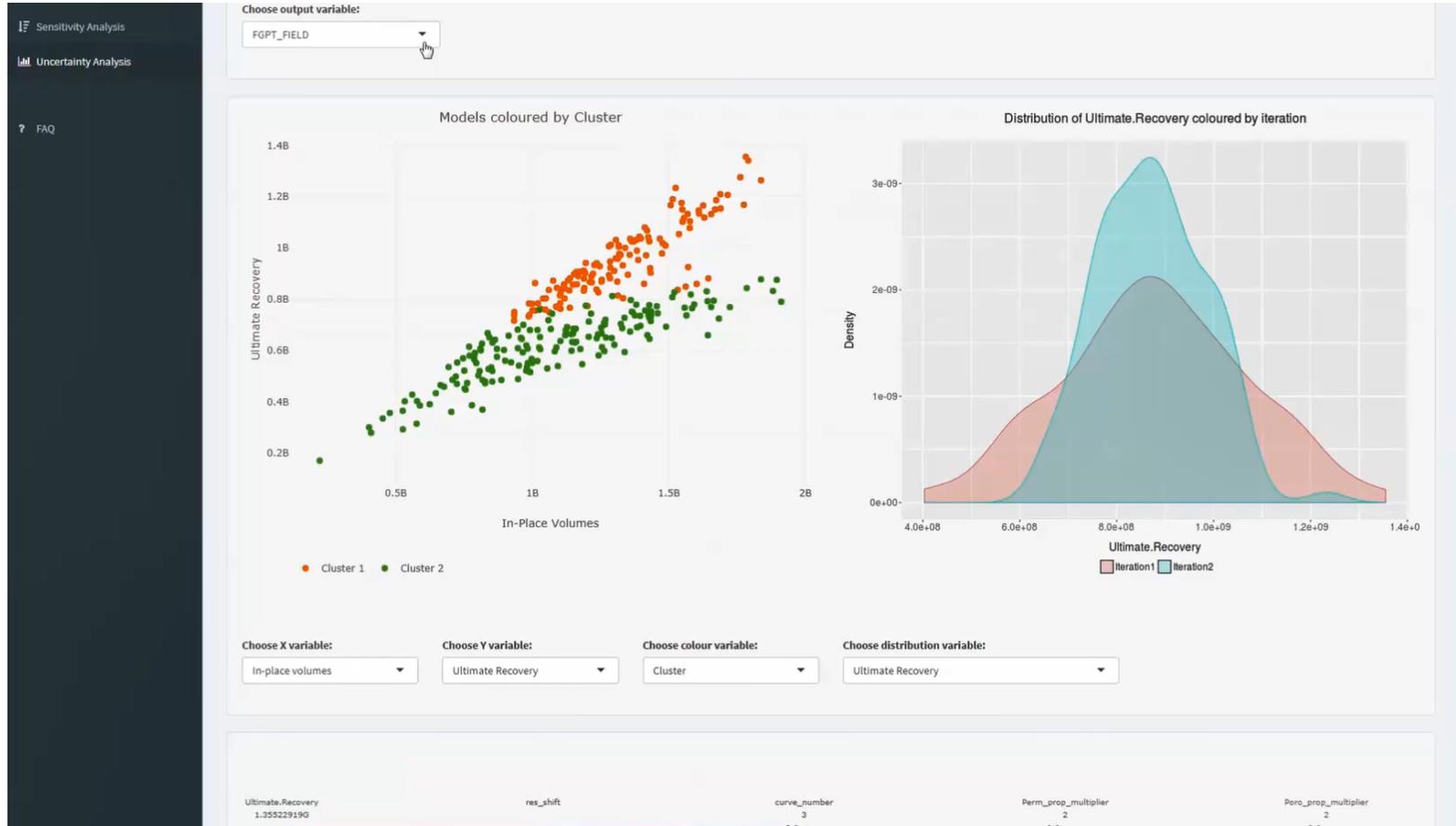
The screenshot shows a web browser window with the URL `https://static-modeling-app-dot-sis-lift-and-shift-dev.appspot.com/status`. The browser's address bar and tabs are visible at the top. Below the browser, a dark header bar contains the text "Prototype DELFI Automated static modeling". The main content area has the heading "PROTOTYPE: Automated static modeling".

Inside the main content area, there is a white-bordered box titled "View iteration status". This box contains an "Iteration id" label followed by a text input field containing the value `3bd1ba3e-ce8b-e1b5-db68-27a5eb6f06b9`. To the right of the input field is a dark button labeled "View all instances". Below this is a table with three columns: "Name", "Status", and "Actions". The table is currently empty.

At the bottom of the browser window, a file download bar shows a file named "Datainsights\_recor...zip" with a "Show all" button to its right.



# Automated Insights

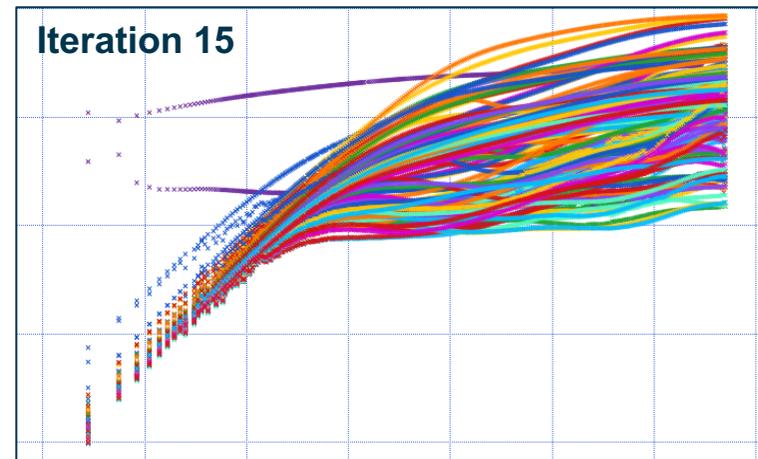
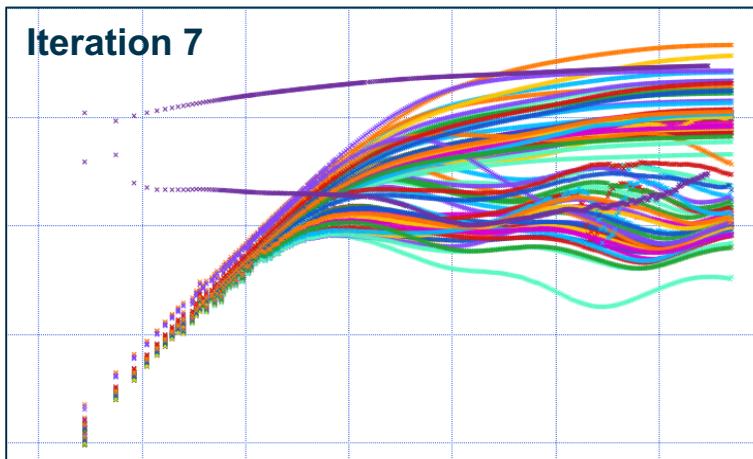
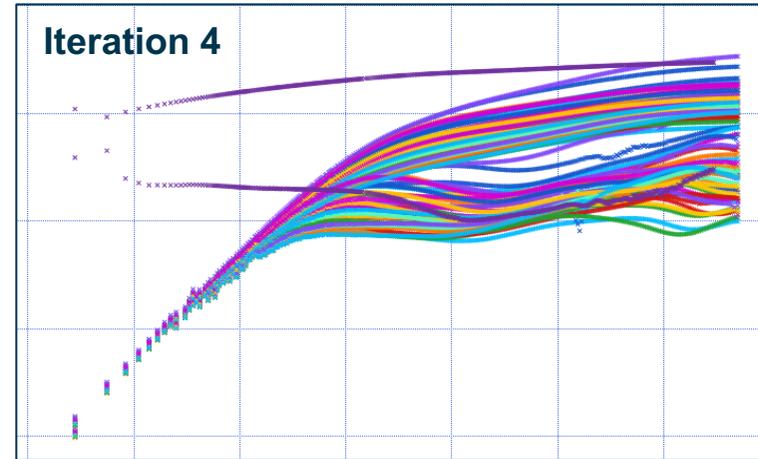
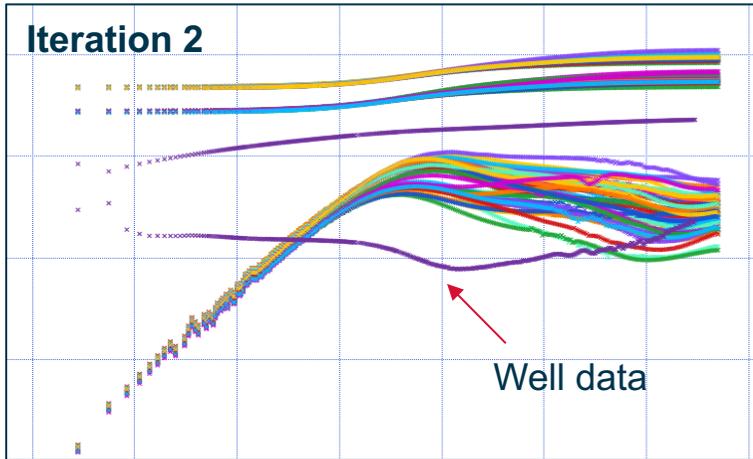


# Appraisal Insights Application

## **Objective: field development insights from appraisal well test**

- Integrated subsurface team identified 36 uncertainties from seismic interpretation to spatial distribution of facies to aquifer strength
- 15 complete iterations in less than a week – each iteration 50 to 100 reservoir models from seismic to simulation
- Process allowed different hypotheses to be robustly tested within an hour
- Twice daily meetings with integrated subsurface team to examine results, discuss hypotheses and plan next iteration
- Prompted a fundamental rethink of net-to-gross and permeability log interpretations

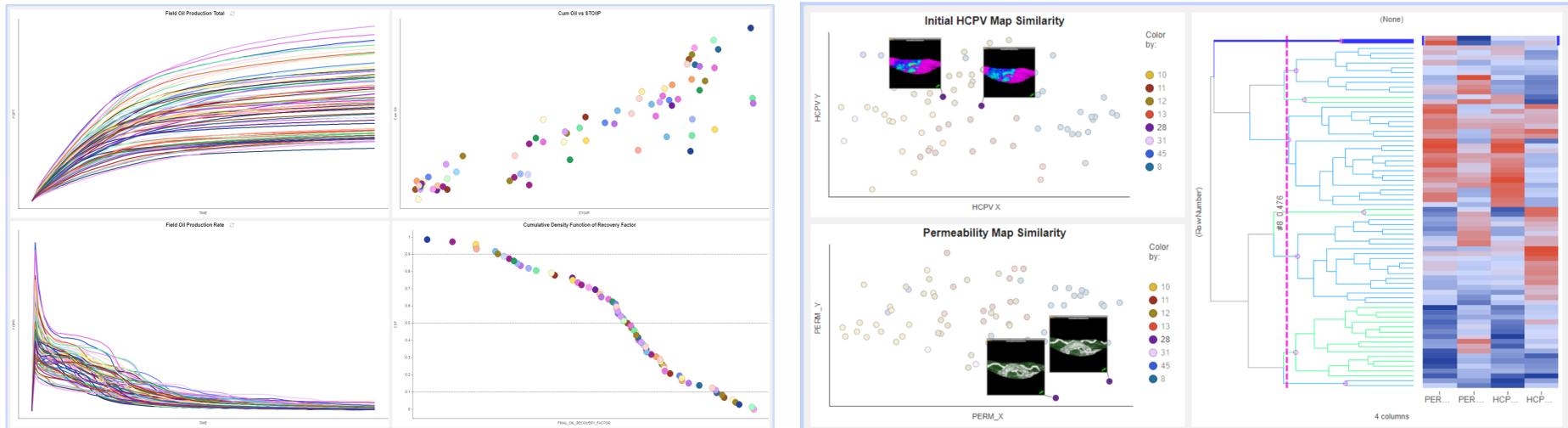
# Appraisal Insights Application



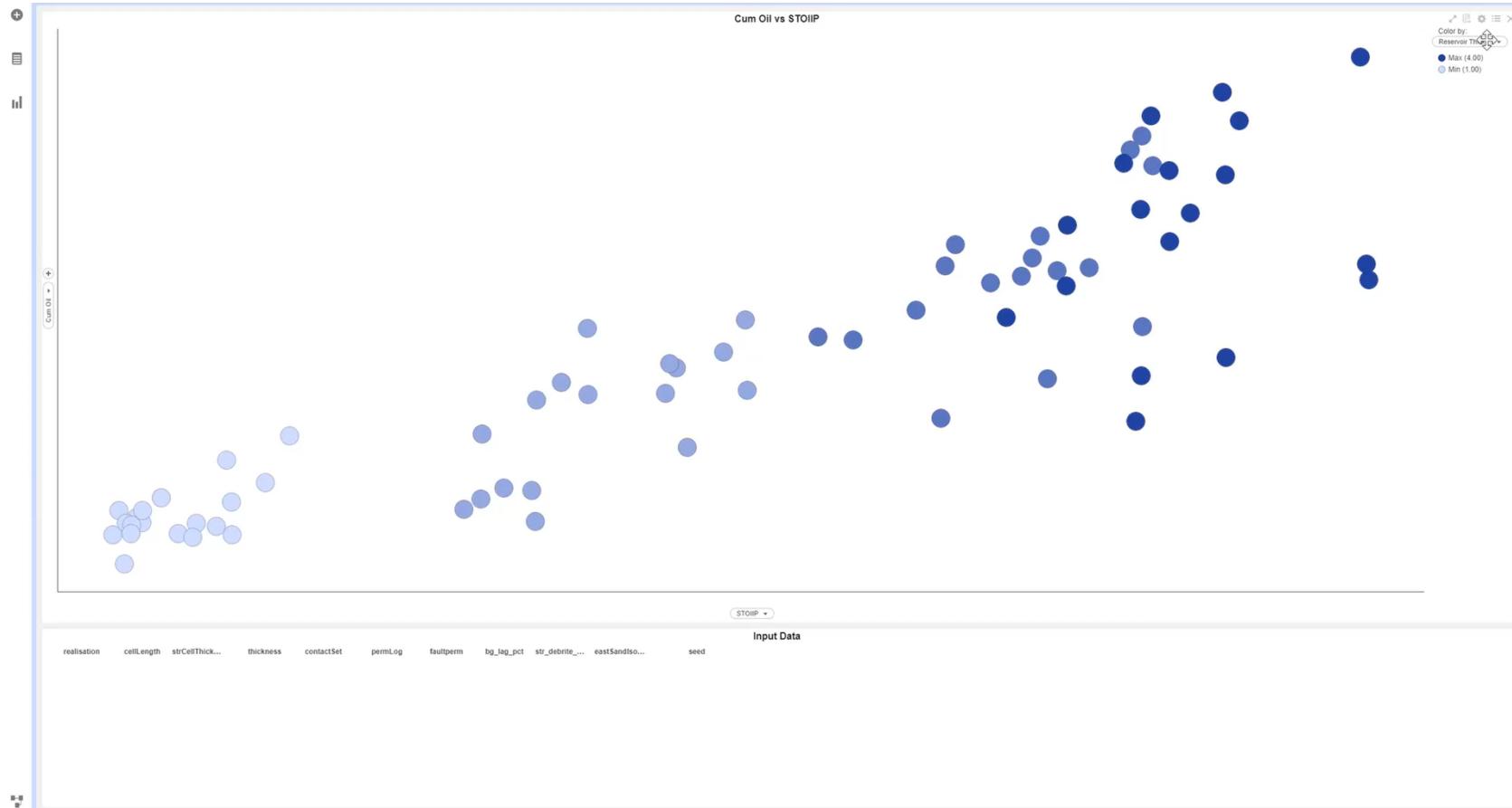
# Oil Field Development Application

## Objective: reserves update for oil field development with production data

- Two hours to complete full iteration of 300 unique reservoir models with forecasts
- Fully linked static and dynamic QC with production data calibration for model falsification
- 75% reduction in model cycle time



# Oil Field Development Application



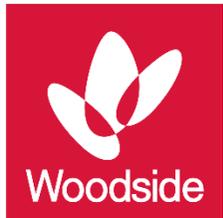
# Conclusions

- DELFI's openness allowed for a fundamental reframe of the reservoir modelling process, with a strong focus on automation, speed and data management.
- Applied to greenfield, appraisal and brownfield applications with significant improvement in model cycle times, collaboration between disciplines and better uncertainty range quantification.
- Access to APIs and cloud compute can streamline workflows to get almost real-time results from modelling studies.
- Removing manual and siloed work allows subsurface professionals more time to collaborate, to explore, and to improve development outcomes.

# Special Thanks

Thank you to Steve Freeman and everyone at SIS Perth, Leeds, Abingdon and Oslo.





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